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ABSTRACT

A study was conducted to test an hypothesis relating semantic structures to cognitive development, specifically that the mean number of associative complexes used by a group of children will be significantly greater than the mean number of associative complexes used by a group of adolescents. The word game "Password" provided a simulation of a speech communication context. Pilot studies helped determine the test words, the reliability of the judges, and the most effective method of playing the game. Subjects were 54 fourth graders, ages 9 and 10, and 52 high school sophomores and juniors, ages 15 and 16. Clues and guesses were sent and received through the judges, who acted as intermediaries. Although results did indicate that the semantic system differed across the two age groups and that there is a semantic component in speech, associative structures were more prominent when adolescents were engaged in sending behavior and when children were engaged in receiving behavior, a finding opposite of the prediction of the hypothesis. Explanations of this result must be extremely tentative, but perhaps the age range selected for this study was not really representative of a separate semantic state, or perhaps the semantic model is appropriate for decoding but not for encoding. This speculation suggests a fruitful avenue for future research. (JL)

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The Development of the Semantic System

presented
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Introduction

How do words mean? In what ways do symbols gain their pragmatic significance? These questions have been haunting scientists in many behavioral sciences. The first attempts at investigating these questions empirically produced contradicting and unsatisfying results.

Research into the nature of the interaction of speech and thought only implies answers to the questions posed at the beginning of this essay. Although the implications from this type of research fall short of explaining meaning, these endeavors operate from a well developed theoretical base which provides a model for the classification of semantic structures.

What follows is a fair but terse representation of research attempting to explain semantic processing. This review is followed by an explanation of what has been learned from studies attempting to explain speech-thought interaction. A classification of semantic structures is created by employing a cognitive analogue. Hypotheses are derived, and an explanation of the testing two of these hypotheses concludes this monograph.

Research about Meaning

Research aimed directly at exploring the semantic aspects of speech communication are less conclusive than the studies of thought and language. Meaning has been investigated employing one or more of the tenants of association (e.g. Bousfield, Whitemarsh, and Danick, 1958; Marshall and Cofer, 1963; Rothkopf and Coke, 1961) but these approaches appear unable

to account for the wholistic nature of speech (Brown, 1970, Deese, 1965) or the full range of linguistic development (Fodor, Jenkins and Saporta, 1967; Vygotsky, 1962) or linguistic creativity (Chomsky, 1972a).

Another approach viewed meaning as the product of generalization. There is the Soviet approach to generalization (e.g. Luria, 1966; Razran, 1968) and the western Whorfian approach (see Carroll, 1956). The criticisms of generalization are similar to those of association (see Miller, 1967), and the experimental validity of the approach may also be criticized (Terwilliger, 1968; Cole and Maltzman, 1969).

Meaning may be viewed as a mediational process. Semantic stimuli may be engaged by past learning (e.g. Russell and Storms, 1955), dimensions of evaluation, potency and activity (Osgood, Suci and Tannenbaum, 1961), or the all controlling set of generative rules (Chomsky, 1972b) before a "meaningful" response is produced. Criticism which is unique to this approach is Steiner's comment that the creative aspects of language present a paradox to this research (see Hall, 1973).

Reviewing the experimental literature focusing on meaning led to the following conclusions: (1) word meanings may be created by associative, generalist, or mediational processes; (2) word meanings may be created by processes not normally regarded as associative and/or generalist and/or mediational relational processes; (3) no one approach, whether association, generalization, or mediation, appears sufficient for explaining the total range of ways of creating word meaning; and (4) each of the approaches lacks either the comprehensive statement of cognitive development or the comprehensive statement of speech development necessary to explain thought-speech interaction and, apparently, necessary in order to create a comprehensive statement of meaning which can account for semantic creativity.

The Interaction of Speech and Thought

The inability of generalist, associative or mediational approaches to explain speech-thought interaction may be the product of each of these approaches failure to identify semantic information processing as part of a large information processing system. Katz (1972) did provide a broader view, but, at the same time, his model provided discrete subsystem boundaries enabling the researcher to identify steps in the coding process. A derivation of Katz's theory is represented in figure 1.

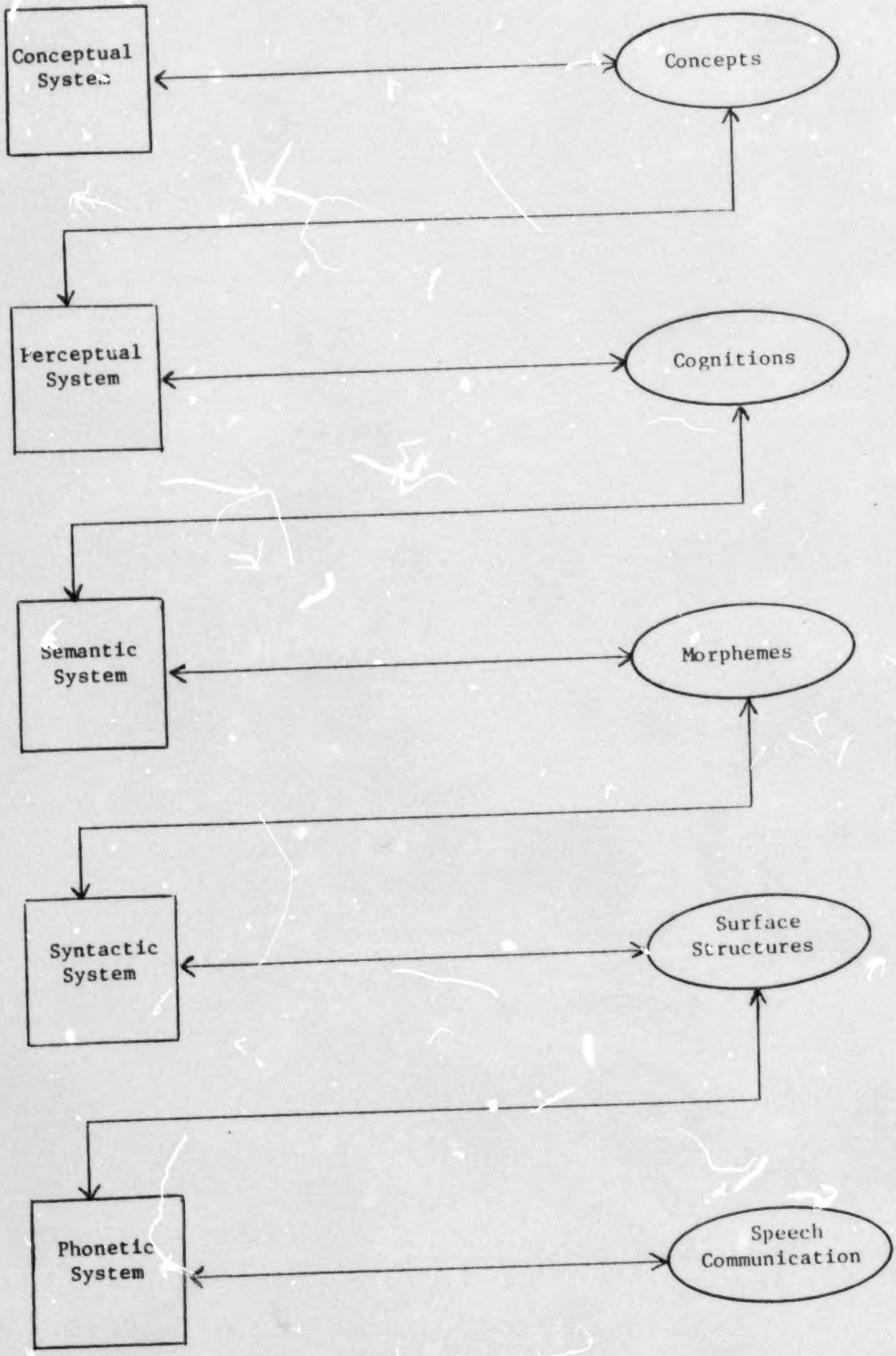
Figure 1 about here

The production and comprehension of speech communication involves at least five information processing subsystems: a) a conceptual system, b) a perceptual system, c) a semantic system, d) a syntactic system, and e) a phonetic system. The ultimate products of each system were identified by Katz (1972) as concepts, cognitions, morphemes, surface structures, and ultimately the phonetic structure known as speech. Although the first two systems code thoughts and the last two are clearly processes of speech, the nature of the middle system, the semantic system, contains elements of both speech and thought. At one end of the semantic system is thought and at the other end is speech. The smallest theoretical unit containing both speech and thought is word meaning (Vygotsky, 1962).

Concepts are abstract entities, generalizable representations of phenomena. An interface of concepts produces a cognition, a datable, individualized, particular idea. Cognitions are constitutive systems outputs in so far as they are representations of more than the sum of the individual concepts; cognitions represent the interfacing of concepts.

FIGURE 1

Speech Communication: An Information Processing Model



Surface syntactic structures are summative system outputs. Morphemes are linearized and literalized to form the deep structure which is subject to the syntactic transformations within the system (Chafe, 1970). From an information theory perspective, the surface structure is a more redundant coding of the deep structure. Transformational rules are the program for this coding. Given the deep structure and the operative transformational rules, the surface structure is nearly state determined.

This brief explanation of the encoding of ideas into sound could extend into the phonetic system. The movement from syntactic structure to phonetic structure is similar to the process of moving from the deep structure to the syntactic surface structure. The entire encoding process may be summarized in the following way: in encoding thoughts into speech, the codings of the subsystems of thought are constitutive while the codings of speech are summative.

The decoding of sound into ideas is a simple reversal of the encoding process. The codings of speech are now constitutive. When decoding one must intuit the meaning from the syntax in the same way that someone else could only guess how one will combine concepts to form cognitions when encoding.

The coding of cognitions into concepts is a summative process. Katz believed that concepts were generalizable enough such that two people could share the same concept. Given a set of cognitions and a knowledge of cognitive propositions, the resultant concept is nearly state determined.

None of the preceding material explains the relationship of cognitions to morphemes. Little is known or tested. The hypotheses derived for this research were derived from theorems inferred from

what is already known about other cognitive coding processes.

Cognitions, obviously, may be represented in non-linguistic codes and on non-speech markers. The investigation of the non-speech communication representations of thought has often proceeded from a developmental prespective. Since cognitions are the input into the semantic system, the development of thought must be considered before a comprehensive statement of semantic processing can be made.

The development of thought has three stages. For learning to take place in the first stage three things are necessary: a healthy organism, a cooperative environment (one which supplies stimuli which can be easily related) and a system of rewards (a reason to relate). The second stage needs only a healthy organism and a cooperative environment; the reward is internalized. The last stage needs only a healthy organism, one which can now create its own environment.

Bruner (1970) labeled these three stages systems of 1) enactive, 2) iconic and 3) symbolic representation. Vygotsky (1962) labeled these stages as stages of 1) syncretic formation, 2) thinking in complexes, and 3) thinking in concepts. Piaget (1970) noted four stages because he subdivided into two stages what the others had labeled as the first stage; he did this in order to call special attention to the emergence of language.

Although Bruner, Piaget, and Vygotsky differ in the particular labels and age ranges for each level of thought, the following statements appear to be applicable to all three theories: (1) the emphasis in each analysis of thought was not so much on the items related as on the way in which the itmes could be related (each theorist defined the various stages of development according to a system of relations); (2) thought is hierarchical and developmental in nature, i.e., discrete systems of relationship may be identified and organized as to their emergence within the total cognitive process; (3) thought develops from the simplest forms of relationship to

the more complex systems of relationships.

From a systems perspective, it may be said that thought develops from states of low differentiation of reality to states of high differentiation. At first the child only perceives a buzzing, whirling world (Piaget) and moves to a state where he not only perceives himself as separate from his environment but is able to make discrete observations about how he interacts with parts of his environment.

Semantic Development

One inference drawn from the preceding review is that the semantic system is subject to developmental stages. Another inference is that each successive stage of development is more complex, more differentiated and integrated, than the preceding stages. What are these stages? Can the paradoxes existing in the current investigation of meaning be resolved by these developmental assumptions?

No one of the three research approaches to meaning provided a hierarchical classification of semantic structure. Linguistic and generative approaches seem inappropriate as a model for the classification of semantic structures because the linguistic and generative theories contain a syntactic and linear bias. All of the cognitive theories can serve as a model for a classification of semantic structures, but some cognitive theories are more specific than others.

A Synopsis of Cognitive Theory. Bruner (1970) provides three stages of cognitive development or modes of representation. The stages important to the study are the second and third stages, the iconic system and the symbolic system of representation. Bruner describes the iconic system as the selective organization of percepts and images

according to the spatial, temporal, and qualitative structures of the things being related and the symbol system as representations of the design features of reality including the symbolic features of remoteness and arbitrariness. Bruner does not, however, provide a list of specific systems of relating qualities at the iconic stage or an explanation of particular design features in the symbolic stage.

Piaget (1970) provides four stages of cognitive growth. The stages which concern this study are the last two stages of development, the period of concrete operations from age seven to age twelve and the period of propositional operations beyond age twelve. The period of concrete operations is described as a stage when objects are classified according to their similarity or difference, serialized or classified in some way according to a concrete operation; the period of propositional operation is characterized not only by reasoning about concrete operations but about hypotheses about those operations. The explanation of the concrete operations is more specific than Bruner's explanation of iconic representation, but, at the propositional level, Piaget is still not specific about the types of hypotheses related or how the hypotheses are related.

Vygotsky (1962) provided three stages of cognitive development. The stages which concern this study are the period of cognitive complexes and the period of scientific concepts. The period of cognitive complexes is extensively subdivided and specified and will be explained shortly. The period of scientific concepts, however, is distinguished from complexes in that thinking in complexes is characterized by the abstraction of one dimension from reality while thinking in scientific concepts is characterized by a synthesis of those dimentions into a whole or concept. There is, however, no specification or classification on

the ways in which such synthesis is achieved; there is nothing comparable to Vygotsky's analysis of the stage of cognitive complexes.

A Summary of Vygotsky's Analysis of Cognitive Growth

Vygotsky conducted a series of experiments in the development of thought. Subjects of various age groups were given twenty-two blocks varying in color (five different colors), shape (six different shapes), height (two heights), and size (two sizes). On the underside of each figure was a nonsense syllable; the subject was given one of the figures and asked to find the others like it. The different age groups were characterized by a specific way of grouping the blocks. These groupings were the basis for Vygotsky's classification of cognitive complexes.

The most primitive form of cognitive complex is called an associative bond. The subjects grouped the blocks on the basis of any one common bond, a similarity, a contrast, proximity, etc. In Vygotsky's experiment, the subjects might group all the red blocks in one group and the non-red blocks in another, for example.

The second type of cognitive complex is called a complimentary or functional bond. In Vygotsky's experiment, the subjects grouped blocks in a way that all the groupings fromed squares. The underlying commonality is that the objects related are related on the basis that they complete an operation or on the basis that the objects form the same configuration.

Chain complexes are the third type of cognitive complex. In the experiment, a red triangle was associated with a red square, and then the red square was associated with a yellow square. The three elements, when grouped together, comprise a chain in that the link between any two consecutive elements or blocks may be on the basis of a common

similarity, but the total chian is dependent on maintaining the order of the grouping.

Diffuse complexes are marked by an arrangement which marks the fluidity of the attribute used to arrange the blocks. In the experiment, the subjects would arrange the blocks in a line from the most red block to the least red block, for example.

All of the previous cognitive complexes rely on the arrangement of the blocks based on a common attribute which actually existed in the blocks. Recognition of that attribute changes the diffuse complex into a pseudo-concept, the last type of cognitive comples. In Vygotsky's experiment, after the subjects were presented with three new blocks and asked to select the block which came next in the diffusion. Identification of the proper block indicated an awareness of the attribute diffused and evidence of an emergent process of abstraction.

Vygotsky's complexes correspond to Bruner's iconic representation and Piaget's concrete operations in that all three describe the stage as relations depended on an attribute actually existing in the objects related. The first types of complexes also conform to the associative approach to meaning in that the first complexes are grouped as a function of similarity, contiguity, or frequency; it may be no accident that the first cognitive complex is called an associative bond.

The chain complex and the diffuse complex bear a resemblance to mediational learning by paired associates. Recall that in mediational learning by paired associates, one relates A to C because one previously has related A to B and B to C; B is said to mediate. When one relates a red triangle to a red square which is also associated with a yellow square, one may relate a red triangle to a yellow square with the red

square mediating.

Vygotsky, Bruner and Piaget describe the last stage of cognitive development in a similar fashion. A synthesis of attributes, Vygotsky's description of scientific concepts, would seem to correspond to design features of reality, Bruner's description of symbolic representation. Such design features may be considered as hypotheses or judgements about reality, Piaget's description of propositional operations. Additionally, one might assume that a set of grammatical rules (Chomsky) represents the design features of hypotheses about language.

A Classification of Semantic Structure

The similarities in the description of language, thought, and meaning suggested a similarity in hierarchical development. In cognitive development, one apparently moves from a system of relating dependent on the attributes inherent in the items related to a system relating dependent on the previously formed judgements about those items. Semantic structure should, therefore, move from a system of relating dependent on attributes inherent in the word meanings to a system of relating dependent on judgments about those word meanings.

A hierarchy is suggested using the three experimental approaches reviewed at the beginning, i.e., generalization, association, and mediation. On the one hand is a system of creating meanings by generalist and associative principles, and on the other hand is a system of relating meaning as a function of a deductive base. A classification of semantic structures corresponding to associative principles can be accomplished with a greater degree of certainty than a classification of semantic structures relying on a deductive base because, as has been noted earlier, the description of cognitive associative operations is more

extensive and more specific than is the description of the design features or propositions or set of rules. Operating from such a set of assumptions and utilizing the description of cognitive structures, a classification of semantic structures was developed.

The first type of semantic structure will be called synonymy. Two words are said to have synonymous relationship when the meanings of the two words are regarded as nearly the same or completely the same, at least to the extent that the words may be used interchangeably within a specified context. The classification, synonymy, is attributable to the associative principle of similarity and corresponds directly to Vygotsky's classification of associative bonds.

Antonymy is the second semantic structure. Words antonymous when one word is regarded, by the user, as having the opposite meaning of the other, at least to the extent that the user regards the words as having an incompatible use. This type of semantic structure, antonymy, corresponds to the complementary bonds of Vygotsky for, when an antonymous relationship exists, the two words become extremes of a range of meaning. In addition, opposites may be regarded as a lack of similarity, sort of a reverse associative principle.

Derivation is the third type of semantic structure. Derived semantic relations arise when two words are related as a function of the multi-ordinality or intercession of a third term. For example, money and food may be related because of the mediating effect of bread (a slang term for money and a type of food). This type of relationship corresponds to Vygotsky's chain complexes and to mediational learning based on paired associates.

Serialization is the fourth class of semantic structure. Words shall be said to be serially related when the difference in meanings between two terms is regarded as a variance in an element common to both terms, e.g., red and pink may be serially related if the user regards one term's meaning as possessing more "redness" than the other. This corresponds to Vygotsky's classification of diffuse complexes and to the associative principle of similarity since the user regards the meanings as having a similar element.

A fifth type of semantic structure is habitualness. A user comes to identify one word's meaning as being the same as another word's meaning because of the frequent use of the two words together. This often happens as the result of advertising; one comes to identify all tissues as Kleenex or all refrigerators as Frigidaires, for example. This corresponds to the associative principles of frequency and contiguity, and habitualness would fall into Vygotsky's classification of associative bonds.

Synonymity, antonymity, derivation, serialization, and habitualness will be subordinated to the term associative semantic structures. Associative semantic structures could be determined because of the relative clarity in explaining associative principles and the relative specification of cognitive complexes and concrete operations. The higher class of semantic structures, corresponding to Vygotsky's scientific concepts, Bruner's symbolic representation, and Piaget's propositional operations, is more difficult to elaborate because of the vagueness in Vygotsky's, Bruner's, and Piaget's descriptions of the higher cognitive states. Some specific structures are suggested for the higer level of semantic structure. This higher level, only the result of inference

from Vygotsky, Bruner, and Piaget, will be called propositional or synergistic semantic structures.

The first type of synergistic semantic structure is the superordinate structure. Two words will be considered as having a superordinate semantic structure when the suer of those words regards the meaning of one word as falling into the class of meanings attributable to the meaning of the second word. This is a type of part-whole structure corresponding to a cognitive distinction necessary for Vygotsky's scientific concepts, i.e., the synthesis of the scientific concept is a whole derived from the single abstractions or parts. The whole-part distinction is also reflective of the symbolic representation of Bruner in that the whole would represent the design features of parts. Superordination is also an indication of Piaget's propositional operations because the wholistic term of the two words represents an hypothesis about the parts.

Characteristic structures are another type of synergistic semantic structure. The user of the two words related sees the meaning of one word as being a quality or operation on the meaning of the other word. Characteristic structures distinguish qualities from kind and operations from objects of operation. This corresponds to the linguistic distinction of agent-action-object of action. Additionally, characteristic structure corresponds to the cognitive distinction of the objects from the qualities of the objects. Examples of characteristic structures are knife-cut, apple-red, and book-read as long as the user does not identify one word's meaning as the other word's meaning.

A third type of synergistic semantic structure is the synthetic or cross-modal structure. Synthetic structures arise when the meaning of

one word is constructed from relating other words in so specific a manner that those other words could not be related in an alternative construct. A cluster of characteristic structures would be evidence of synthesis, e.g., given red-apple, round-apple, and fruit-apple, one might assume that apples may be defined as red, round fruit. Such structures were found by Osgood and have a literary counterpart in sub-structure, the metaphor (see Pollio, 1973, p. 73). Synthetic structures are evidence of the creative aspects of the more advanced aspects of cognitive development.

The specification of synergistic structures is a tentative specification because the synergistic semantic structures do not correspond directly to one or more descriptions of the phenomena at the cognitive level. The synergistic structures are derived only be inference from Piaget, Bruner, and Vygotsky and, from an experimental perspective, must be considered less reliable than associative semantic structures. Nevertheless, the construct of synergistic structures is useful in revising the critical proposition.

Since cognitive growth has been described by Piaget, Vygotsky, and Bruner as a movement from thought characterized as concrete operations, cognitive complexes, and iconic systems of representations at childhood to thought characterized by Bruner, Piaget, and Vygotsky as symbolic representation, propositional operations, and scientific concepts, since the associative semantic structures correspond closely to the childhood stages of cognitive growth and since the synergistic structures are inferred from the adolescent cognitive stages, it would be reasonable to assume that childhood semantic structures could be characterized as associative and the adolescent semantic structures as synergistic. The child should use more associative and less synergistic semantic complexes

than the adolescent, or, when the number of semantic structures is limited and held constant over groups of subjects, the mean number of associative structures should be significantly greater in childhood than in adolescence, and the mean number of synergistic structures will be significantly greater in adolescence than in childhood.

Since the classification of associative structures is more reliable than the classification of synergistic structures, the proposition dealing with associative structures is more reliable. Since the individual characteristics of each subject (except for age) is not at issue and could be accounted for by randomization, the more desirable propositions are those dealing with the prediction of a norm of activity for a group of subjects. The critical and most comfortably testable proposition is the following: the mean number of associative complexes used by a group of children will be significantly greater than the mean number of associative complexes used by a group of adolescents.

Method

Password is a television game show and a type of verbal charade. In charades one member of each team playing (normally only two teams play) is given a famous title or expression, and then, using no words, that one member tries to act out the title or expression so that his team will be the first to guess the title or expression. In Password one member of each of the two two-man teams playing is given the word on a slip of paper; the member given the slip of paper must try to get the other member of the team to guess the word by giving one-word clues.

A word game such as Password produces words in clusters which can be analyzed within the system of structures introduced in the last sec-

tion. Such a word game has the following advantages which make the word game more of a simulation of a speech communication context than other experimental paradigms: (1) some paradigms are not unique to speech or language; the word game model employs exclusively words and the relation of word meaning; (2) words are used in the word game to elicit a proper response by using the meanings of words, and therefore the word game is more a speech communication context than free word association paradigms which do not contain any speech communication intent or interaction; (3) the word game is free of a complicated syntax or forced linearization which makes the analysis of the semantic clusters difficult; a descriptive analysis of a natural speech situation is more difficult due to syntax.

The most obvious problem in the selection of words is that the words must be selected which can be used by the youngest group in the experiment. In addition, a method of limiting words was used to solve the problem of reliability of the judges. The words and how they were chosen, therefore, solve two experimental problems.

An initial pool of sixty words were selected at random from a cumulative vocabulary for grades one and two from Around the Corner, by Dusby and Russell, a Ginn basic reader published in 1961. The cumulative vocabulary was alphabetically arranged in the back of the text. The vocabulary was subdivided into fourths, and fifteen words were selected from each sub-group by using the last numerals from pages flipped randonly in another book. The subdividing strategy was employed only to simplify the selection process by making the number of words within the range of numbers on the pages of the other book.

Two initial pilot studies were conducted to reduce the number of words and to test ten judges for reliability. Two significant results

accrued: (1) the twenty words selected can be used by the members of the youngest group participating in the experiment; (2) judges had at least a 100 percent agreement on the type of semantic structures found when the members of the youngest groups used these twenty words to play the word game. The words used in the experiment are appropriate to the youngest age group and yield a high judging reliability.

Ten additional pilot studies were conducted to determine the most effective method of playing the word game. The following procedure emerged: (1) the original Password game was explained to one subject by one judge, and the game was played by the judge and the subject with a few sample words; (2) the subject was told that he would play the game with a person whose identity was unknown to him, a person he would not see or hear and that the quicker the subject could guess the target words whose clues had been provided by that other person, and the quicker the other person could guess the target words whose clues had been provided by the subject, the more points both would earn (a point system leading to prized was explained); (3) subjects were given ten target words, one word at a time, and subjects were asked to tell the judge five clue words which the subject would use for each target word (clue words may be repeated); (4) the judge recorded each clue word and circled those clue words indicative of associative semantic structures; the total number of circled clue words, for all ten target words, was recorded; (5) the judge informed the subject that it was the subject's turn to try to guess the target words; the judge provided clue words, one at a time, for a second set of ten target words (there were, of course, only five clue words for each target word); the new clue words for the second set of ten target words was provided by the subject immediately preceding the subject currently playing the game; (6)

when the subject correctly identified the target word, the clue word which was given just prior to the correct guess was X-ed out; the number of clue words which were both X-ed out and circled were recorded; (7) the subject was thanked for his time and told that the persons with the most points would be announced and given a prize the following week.

This procedure accounts for the sender-receiver interaction by the X-ed out words. Since the judge mediated the actual playing of the game, the stylistic variables were eliminated. A constant number of clue words was elicited, five clue words for any one target word and fifty clue words for any ten target words. Additionally, the competitive aspects aided in subject cooperation. One judge playing with one of the younger subject took from thirty to forty-five minutes.

These pilots also help determine the age ranges which would be used as representative of childhood and adolescence. Fifty fourth graders, ages nine and ten, were sampled at random from Cherry Hills elementary school of the Cherry Creek School District, and fifty-two high school sophmores and juniors, ages fifteen and sixteen, were selected at random from the high schools of the same school system. The Hollingshead Test of Social Class Difference was employed to insure that both groups were representative of the same social class.

Given these experimental conditions, the following two hypotheses can be restated: (1) the mean number of circled clue words from a word game, played by fifty fourth graders, will be significantly greater than the mean number of circled clue words from a word game played by fifty high school sophmores; (2) the mean number of clue words both circled and X-ed out, from a word game played by fifty fourth graders, will be significantly greater than the mean number of clue

words both circled and X-ed out from a word game played by fifty high school sophmores. A t-test for independent samples was employed.

Results

The test of the first hypothesis produced t= -2.715 (df=100, $p<.005$). Although the score is significant, it is in the opposite direction predicted. The first hypothesis is rejected.

Since the first t indicated a significant difference, the two sample z-test for proportion's was employed to test the following hypothesis: the proportion of X-ed out clue words which are circled, from a word game played by fourth graders, will be significantly greater than a similar proportion from a word game played by high school sophmores. The resultant z score was 3.516 ($p<.002$), in the predicted direction. The second hypothesis was confirmed.

Discussion

The first conclusion was that the semantic system differed across the two age groups. This interpretation is possible because the type of semantic behavior in the word game task did change.

A second conclusion was that the change in the two groups was a structural change. Researchers in the experiment judged word relationships, not the type or frequency of particular words. The total semantic system may be seen as moving to and from steady states. At least, it may be said that the associative steady state is less dominant at one level of maturation than at another.

Related to these conclusions is the observation that there does indeed exist a semantic component in speech and that viewing that

component from a structural or systems perspective is experimentally verifiable.

Special attention must be given to the conflicting results when attempting to verify the hypotheses. What needs to be explained is why associative structures were more prominent when adolescents were engaged in sending behavior and when children were engaged in receiving behavior. An explanation of this pehnomenon is tentative in the extreme.

For the fifty clue words employed by the children, the mean number of circled words was only 6.38; the mean for adolescents was only 8.577. The significance in the t score was produced not by the means, but by the variance. The SS for the children was 599.78; the SS for the adolescents was 1068.69. The children are more predictable in their use of associative structures when encoding than are the adolescents.

Why? Several explanations are possible. One explanation might be that the age range selected for adolescents is really not representative of a seperate semantic state, that the semantic state corresponding to the propositional cognitive state would not really emerge until after high school graduation. This would mean that encoding semantic abilities develop only after the cognitive state is fully developed since the latest specified age for this state was given by Bruner as twelve to thirteen.

The encoding lag must be contrasted with support for the second hypothesis. For the fourth graders .4244 of their correct guesses were based on associative semantic structures while only .2857 of the adolescent correct guesses were explained by associative structures. Such strong evidence for the second hypothesis and the problem with variance

in the first hypothesis might mean that the semantic model, based on a cognitive analogue, is not appropriate for explaining encoding but is the correct interpretation of decoding.

This research does reflect several differences between thought and language. Extensive pilot research was needed to identify the appropriate ages for conducting the research, and the fact that the ages used are a few years older than the ages generally used for testing cognitive processes point to a difference in speech communication as an information marker. It simply takes longer to develop the capacities to code (both encode and decode) information when it is borne on a speech communication marker; it takes longer than it would take to develop the capacities to process information of the same complexity when it is presented in a different form.

Except for this difference in the age ranges that define the various stages, the research presented here supports the notion that decoding information presented as speech communication evolves through states similar to other cognitive processes. The intriguing difference is in encoding, and this seems a fruitful avenue for future research.

No special attention was focused on what types of words were most likely to yield particular semantic structures. An in-depth analysis of the data may yield some interesting results.

The only variable used to specify certain semantic structures was maturation. The experimental model may prove useful in measuring the effects of other variables on the semantic structure.

On possible extension of this research is to study differences between languages. Do some languages lend themselves more readily to transmitting certain semantic structures? What is the effect of

multilingualism?

The word-game model employed in this research is now the only model which has been used to measure the semantic system. That experimental model was used to only measure one steady state within the system. An exploration of alternate empirical models may yeild an alternate model capable of measuring of wider range of states. If such is the case a correlation of speech to thought would be possible.

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